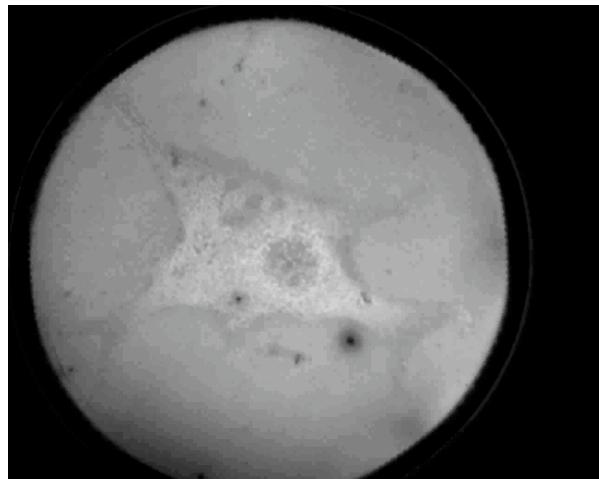


Spectromicroscopy of cells, tissues and minerals at the 10-100 nanometer scale

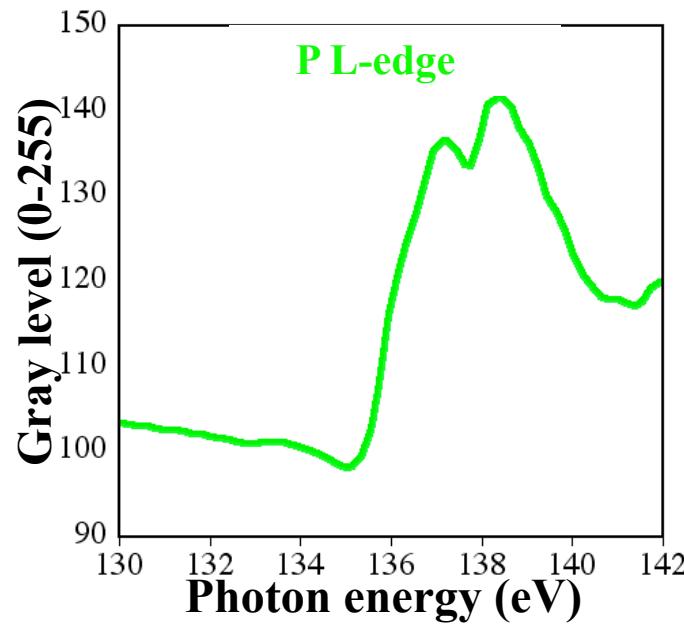
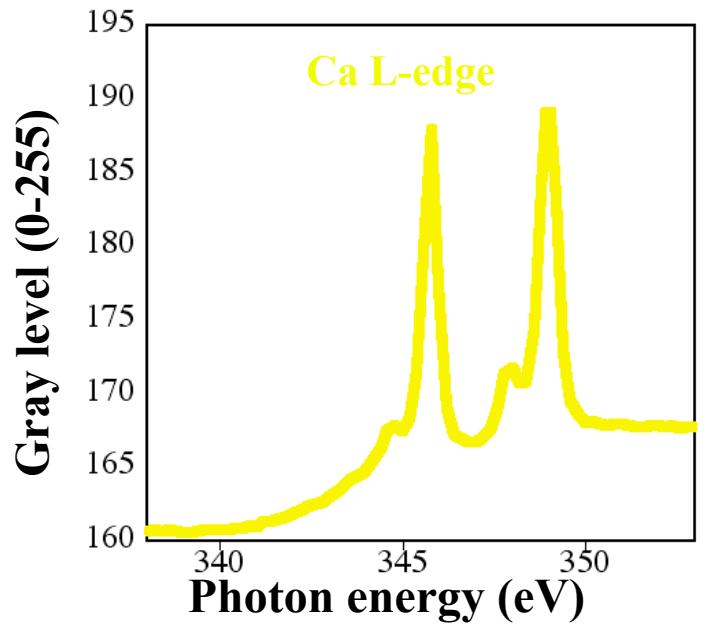
*Gelsomina "pupa" De Stasio
University of Wisconsin- Madison,
Physics Department
and
Synchrotron Radiation Center*

Human Glioblastoma cells (*in vitro*)

microdistribution of elements from x-ray absorption movies

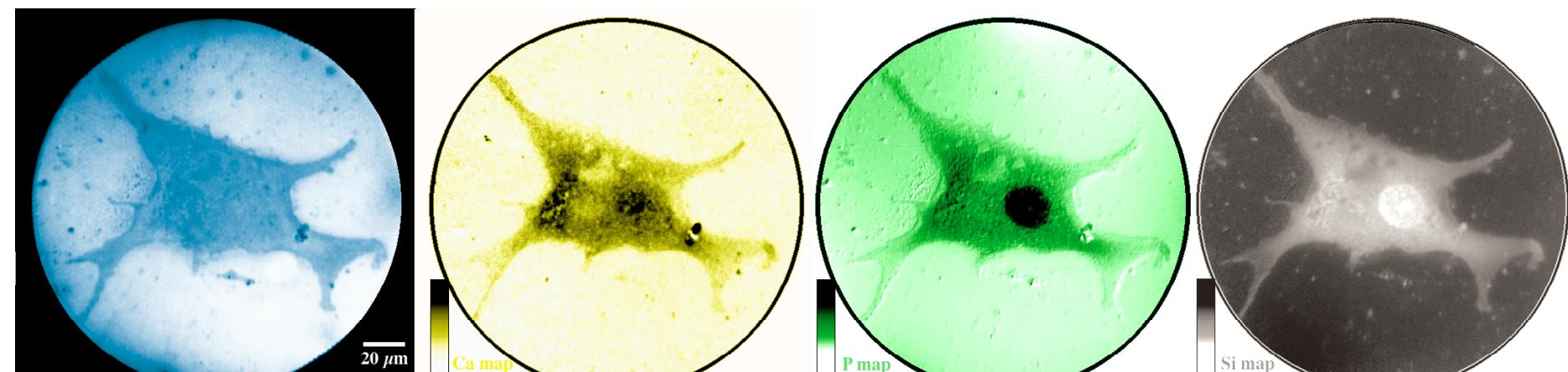
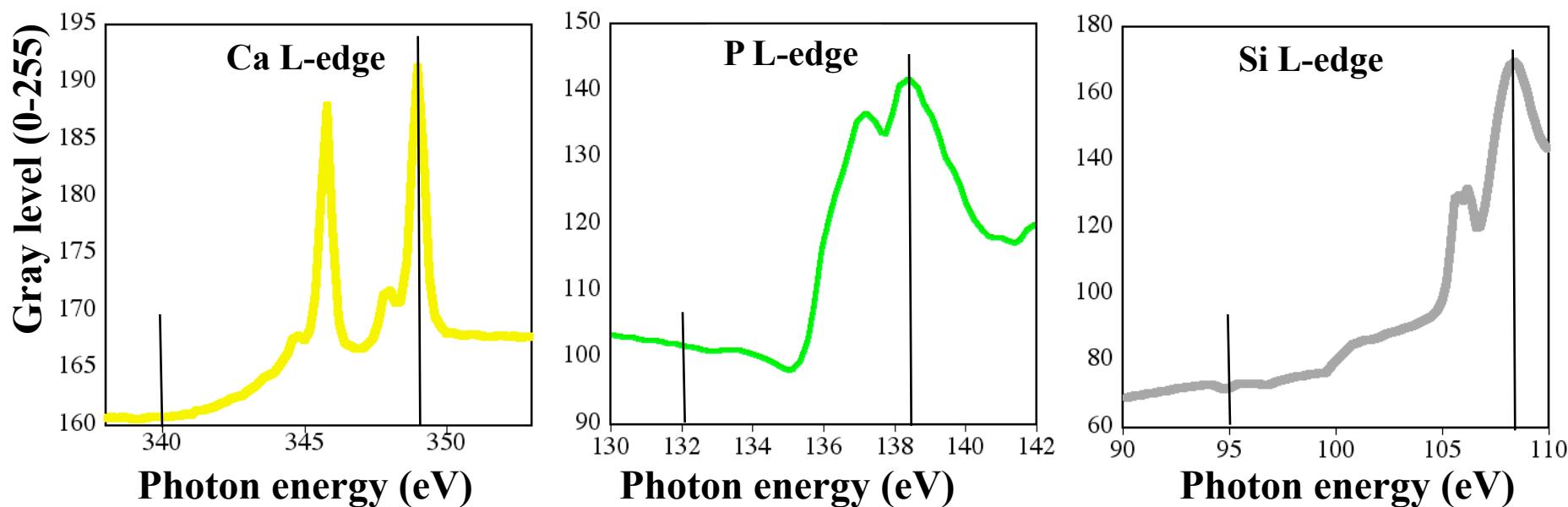


20 μm



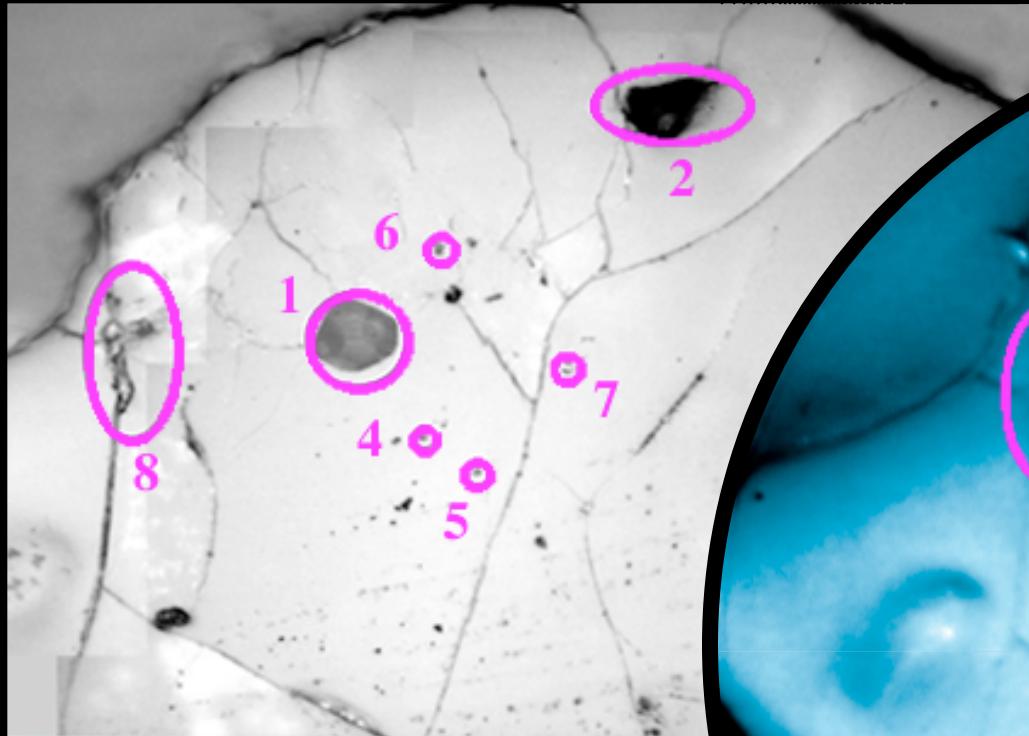
Gadolinium Neutron Capture Therapy

Microchemistry of Glioblastoma cells *in vitro*

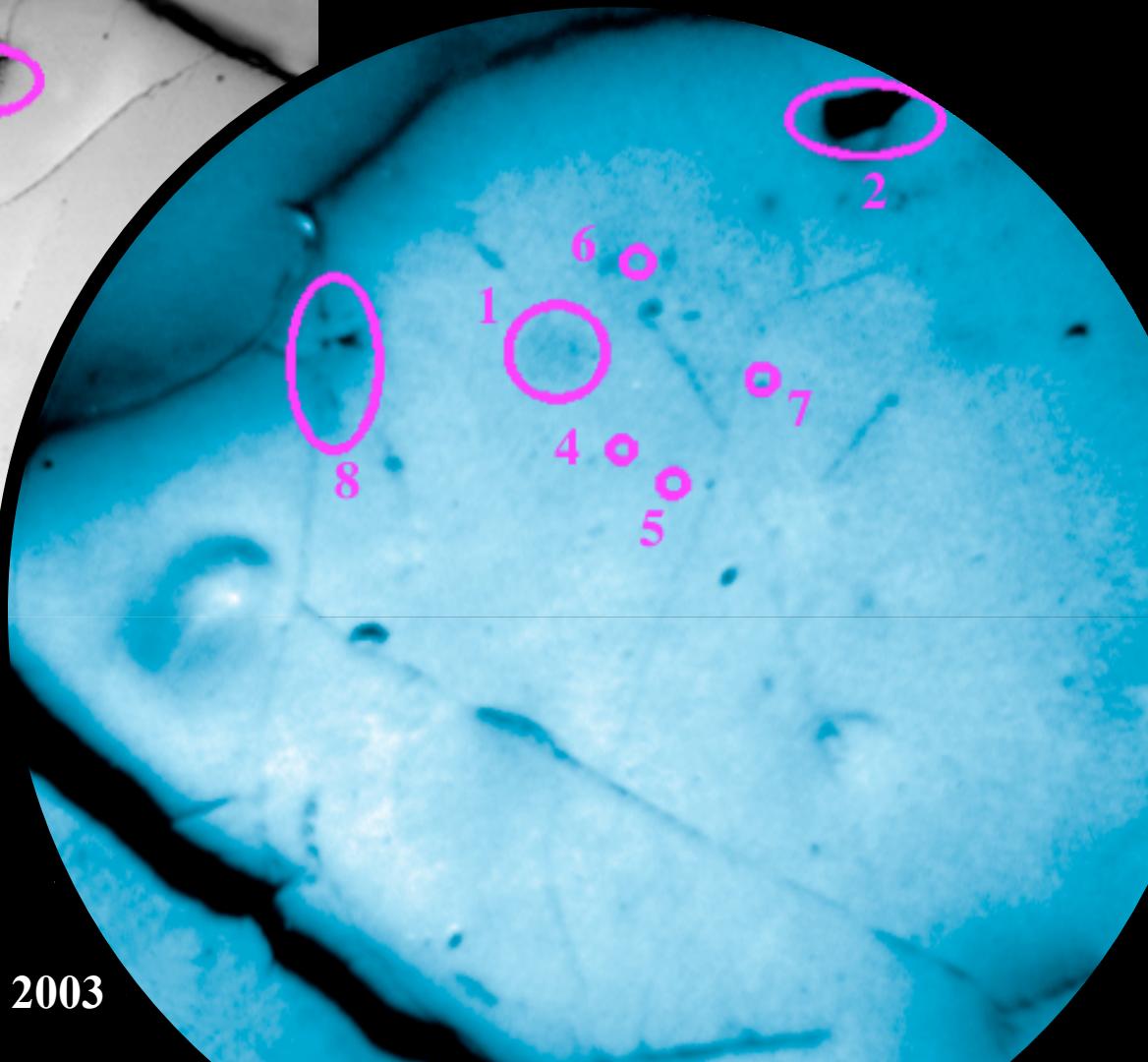


SPHINX analysis of 4.4 Gyr old Zircon from Jack Hills

VLM image



SPHINX X-ray image

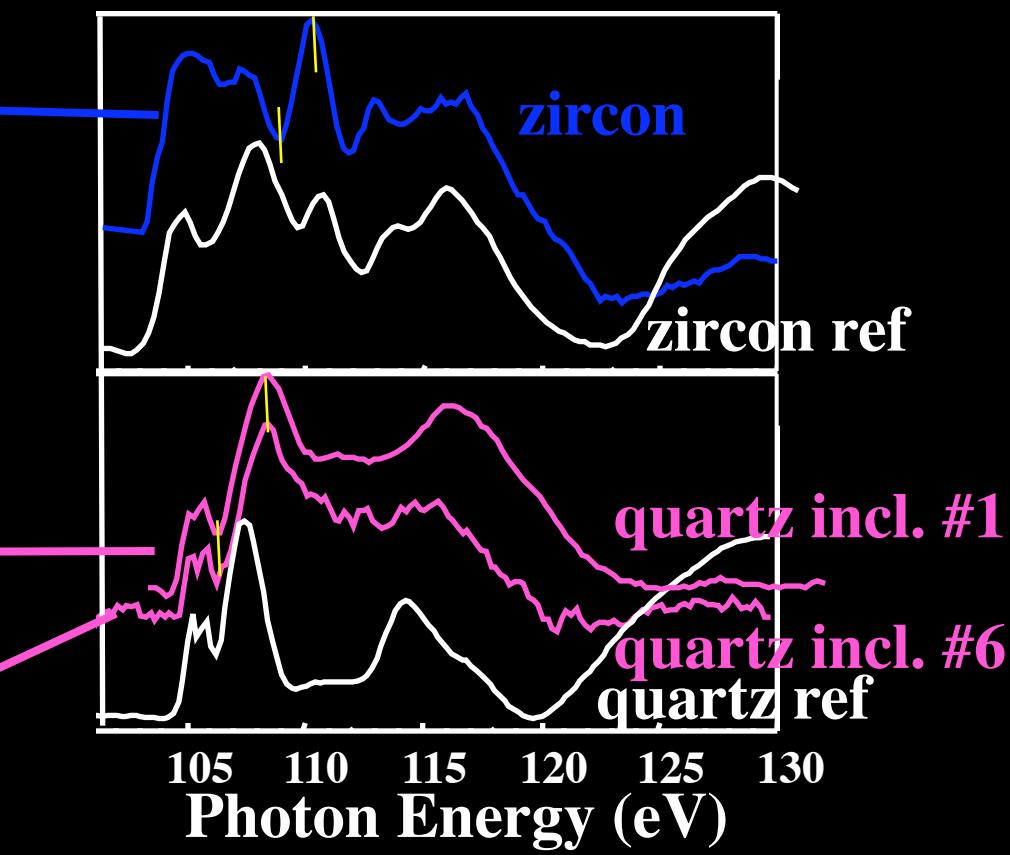
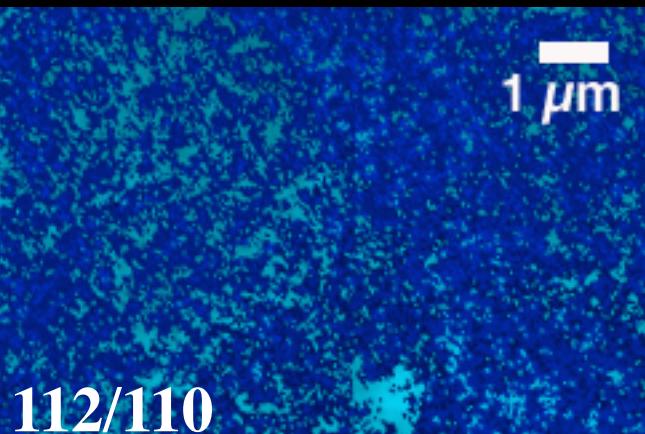
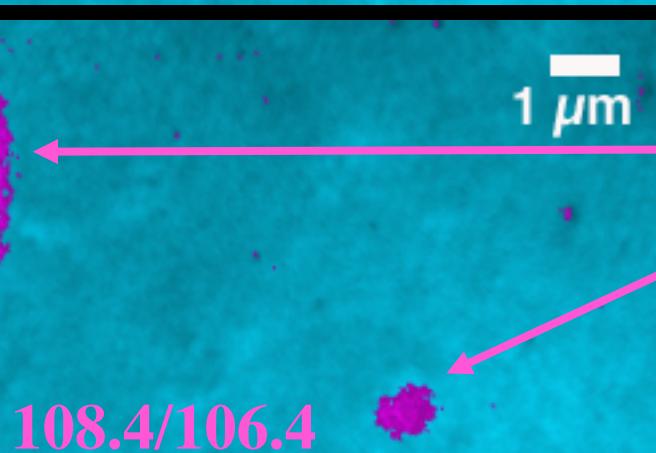
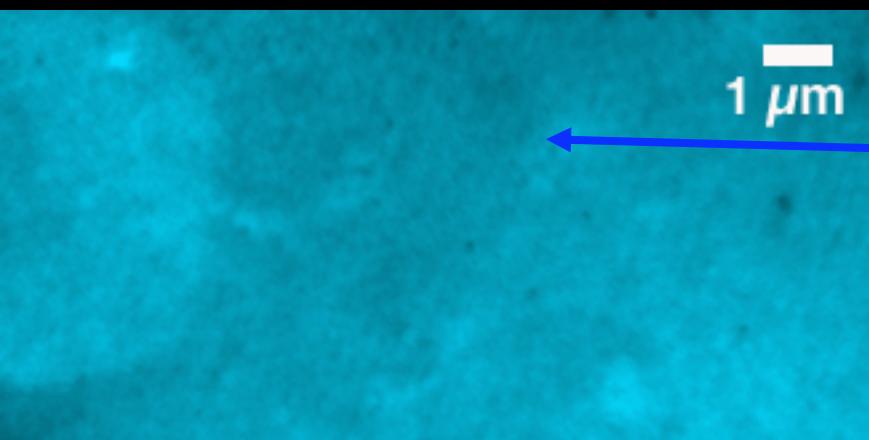


—

10 μm

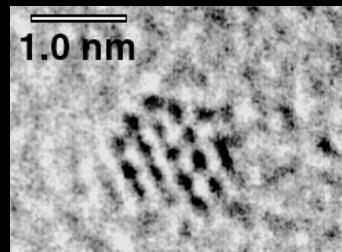
inclusions #1 and #6 are quartz

SPHINX analysis

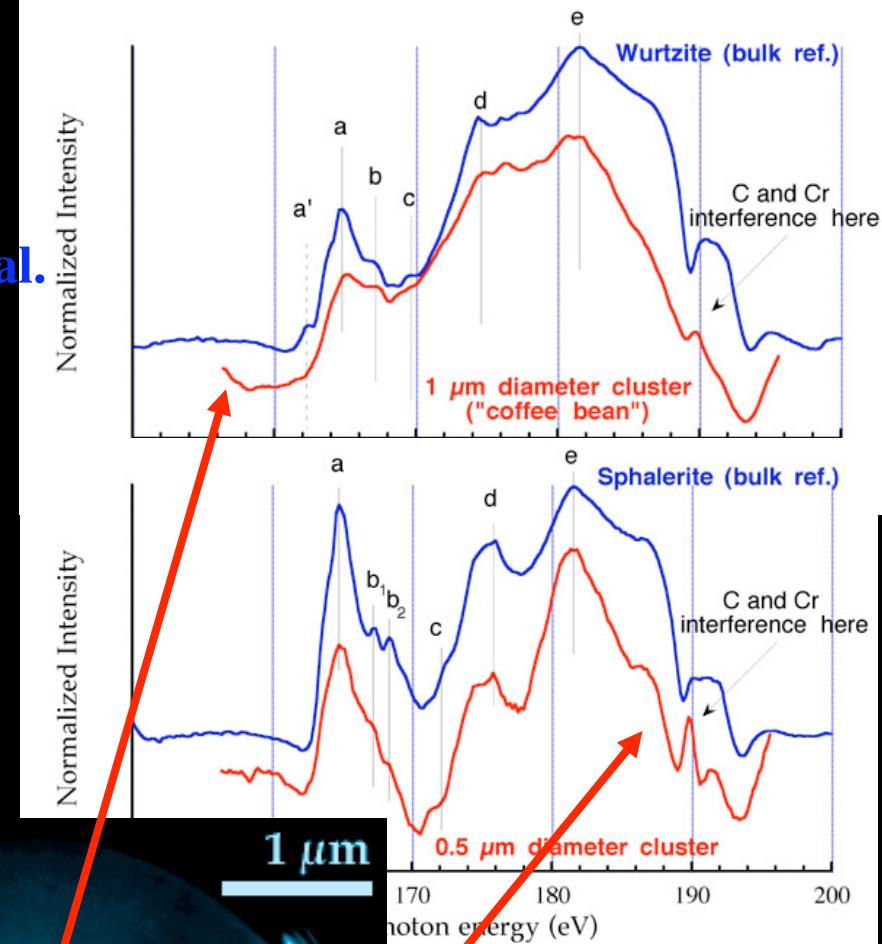


Sulfur Reducing Bacteria (SRB) in Tennyson, WI, flooded mine analysis with SPHINX

Ben Gilbert, pupa De Stasio, Jill Banfield et al.

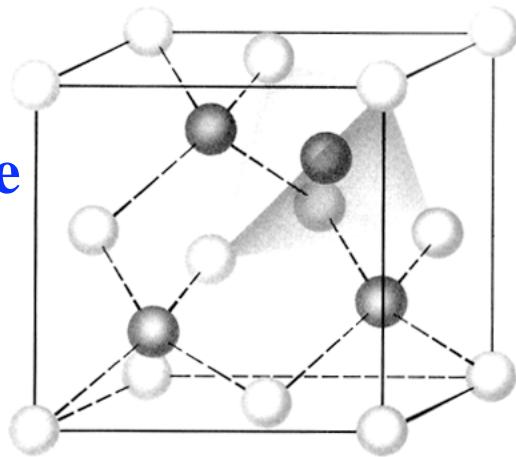


TEM of single
ZnS nanoparticle

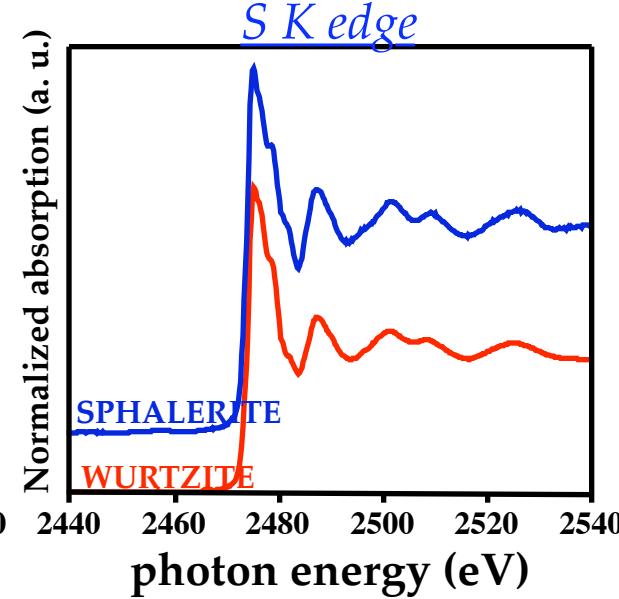
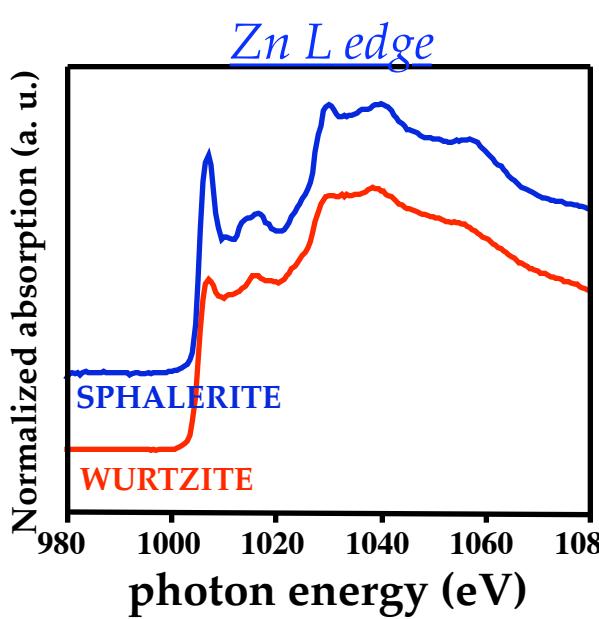
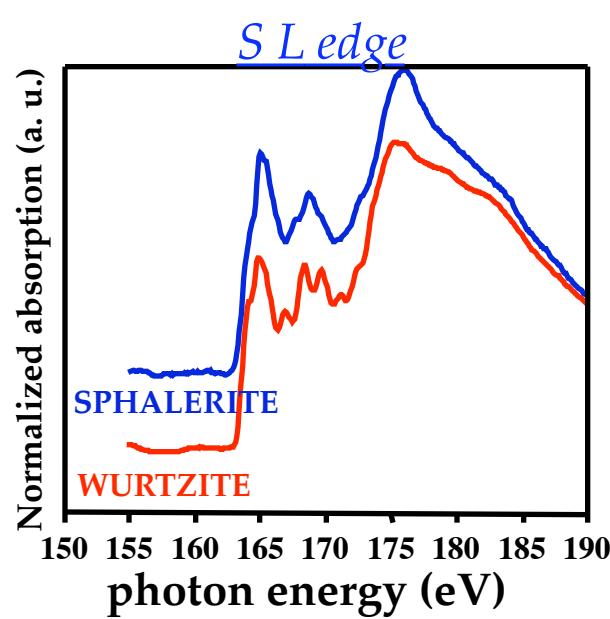
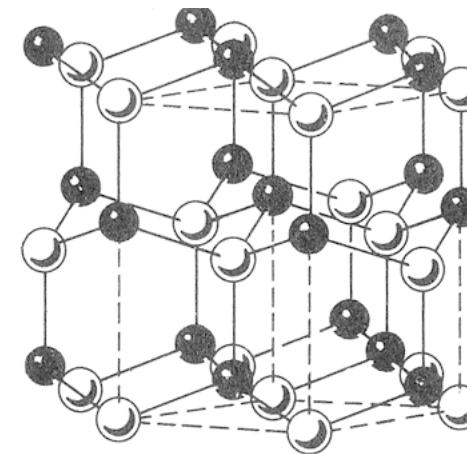


Polymorphs of ZnS with XANES Spectroscopy

cubic sphalerite



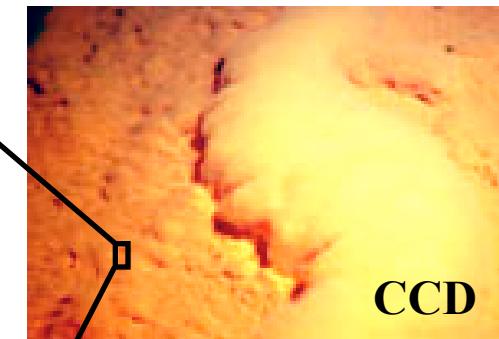
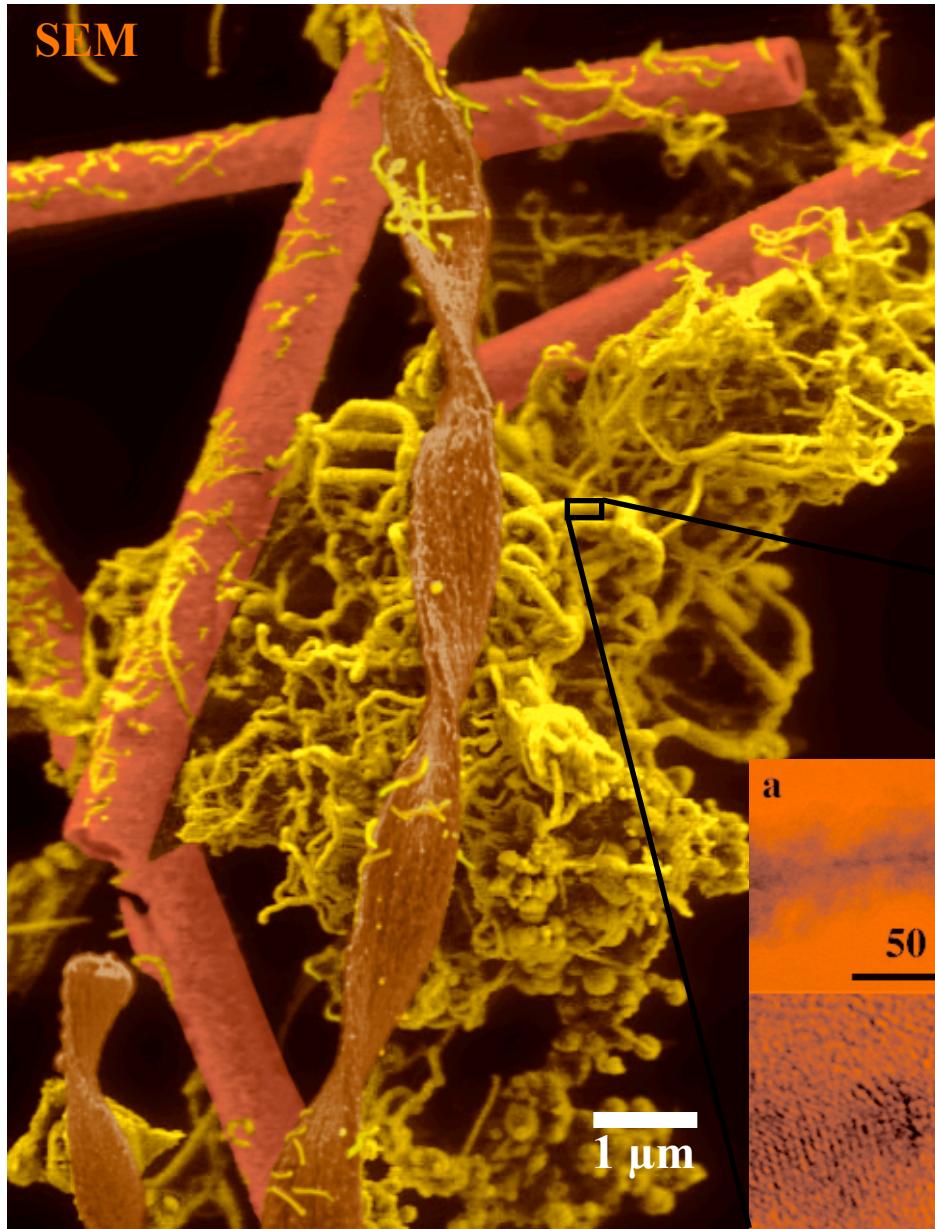
hexagonal wurtzite



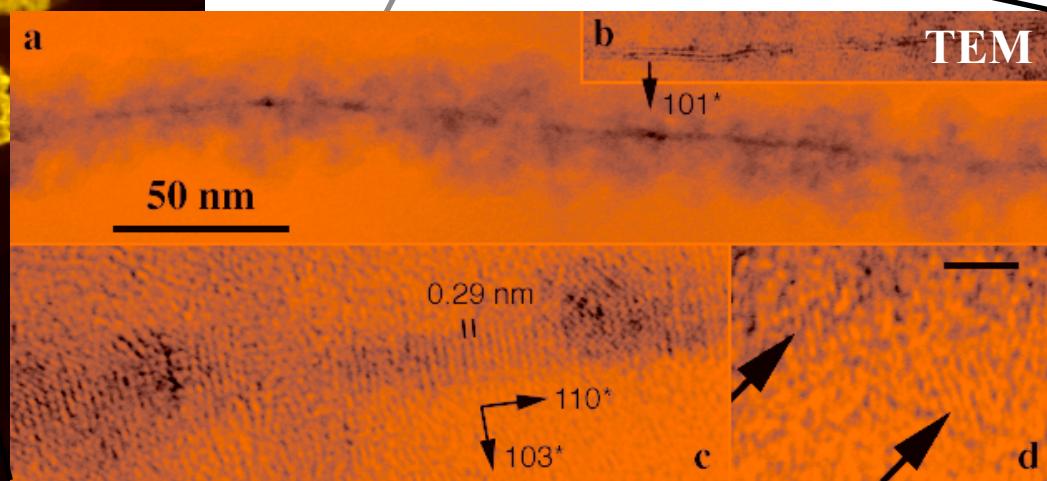
Microbial polysaccharides template assembly of nanocrystal fibers

Pupa De Stasio, Clara Chan, Susan Welch, Marco Girasole, Brad Frazer, Maria Nesterova, Sirine Fakra, and Jillian F. Banfield

Tennyson Piquette Mine (WI) flooded tunnel, ~15°C, fresh water

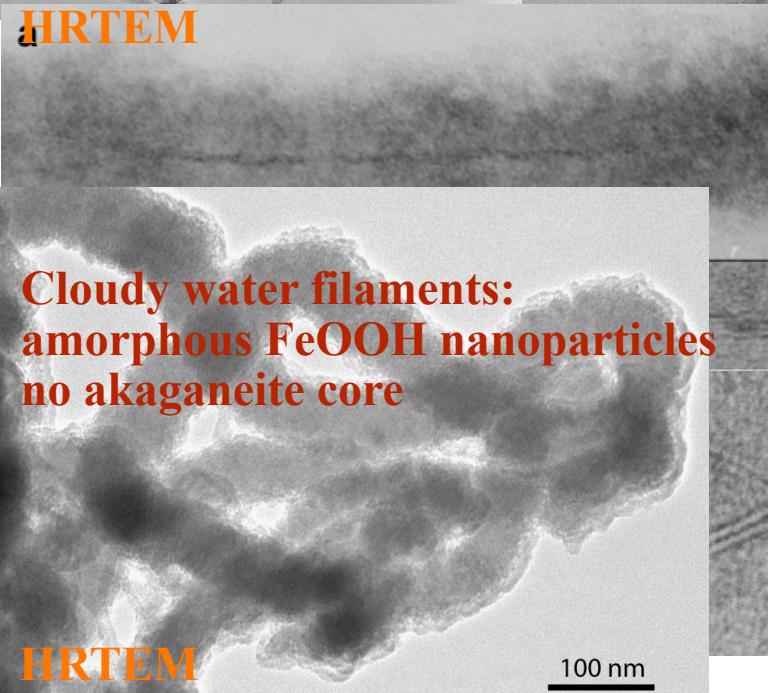
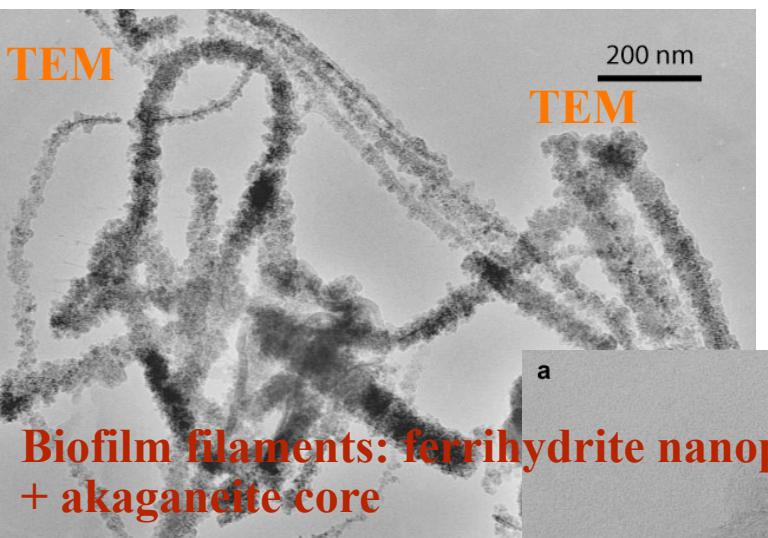


Science 303, 1656-8, 2004

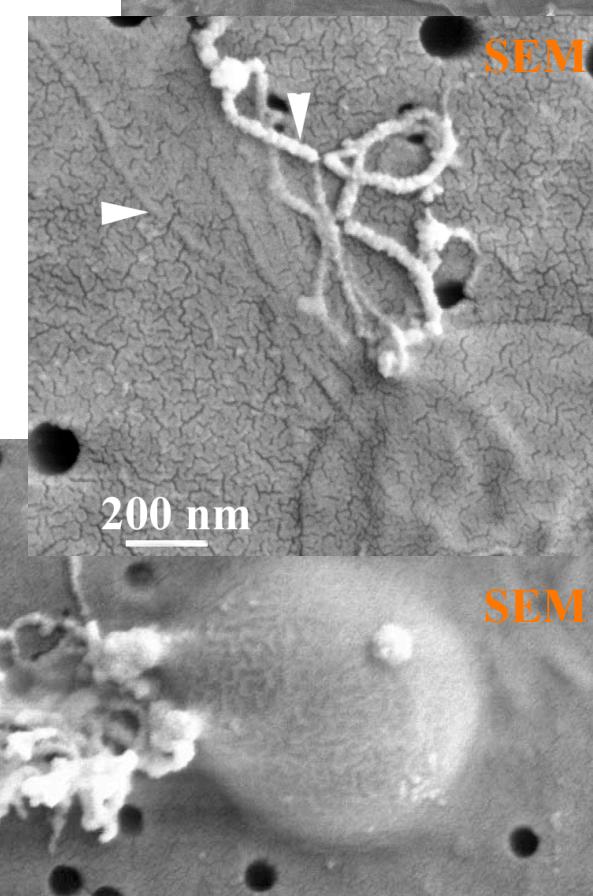
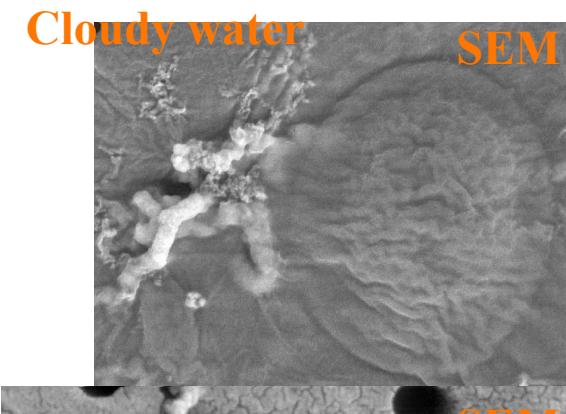


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fresh water
⇒ templation



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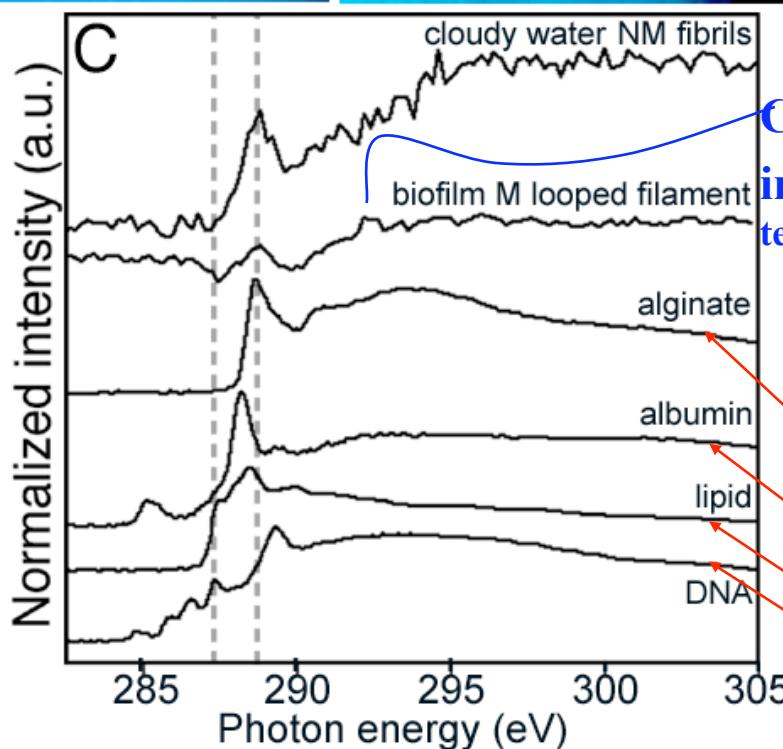
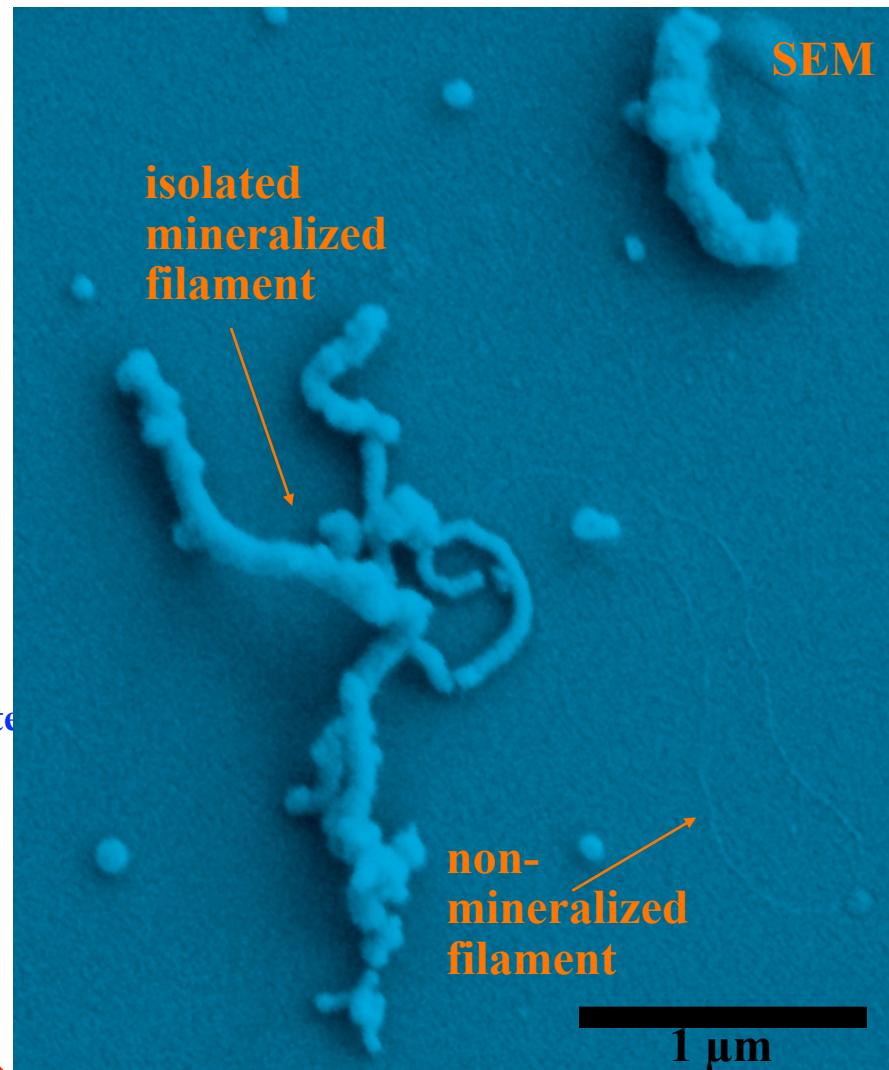
SPHINX images and XANES spectra

Cloudy water filaments

not mineralized



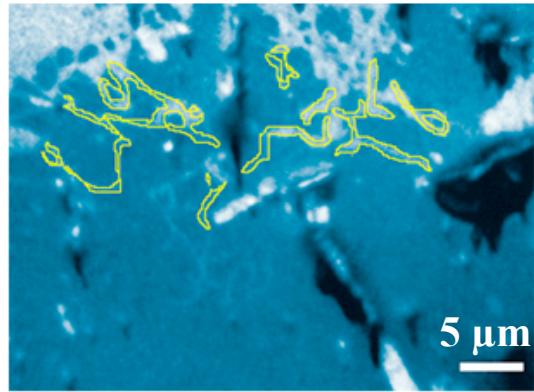
Biofilm filament mineralized



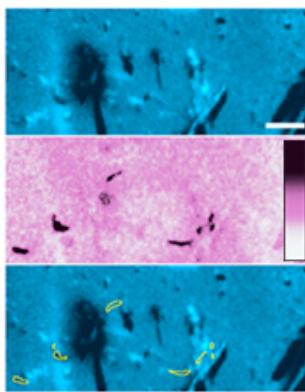
Microbial polysaccharides template assembly of nanocrystal fibers

Pupa De Stasio, Clara Chan, Susan Welch, Marco Girasole, Brad Frazer, Maria Nesterova, Sirine Fakra, and Jillian F. Banfield

Biofilm filaments
mineralized



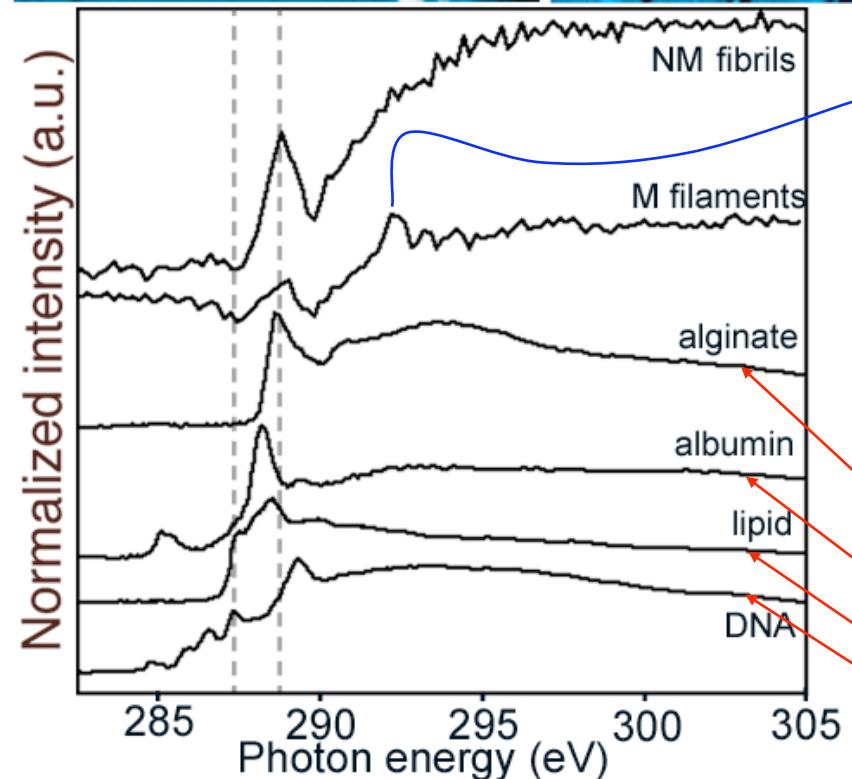
Biofilm filaments
non-mineralized



SPHINX images and XANES spectra

C distribution map

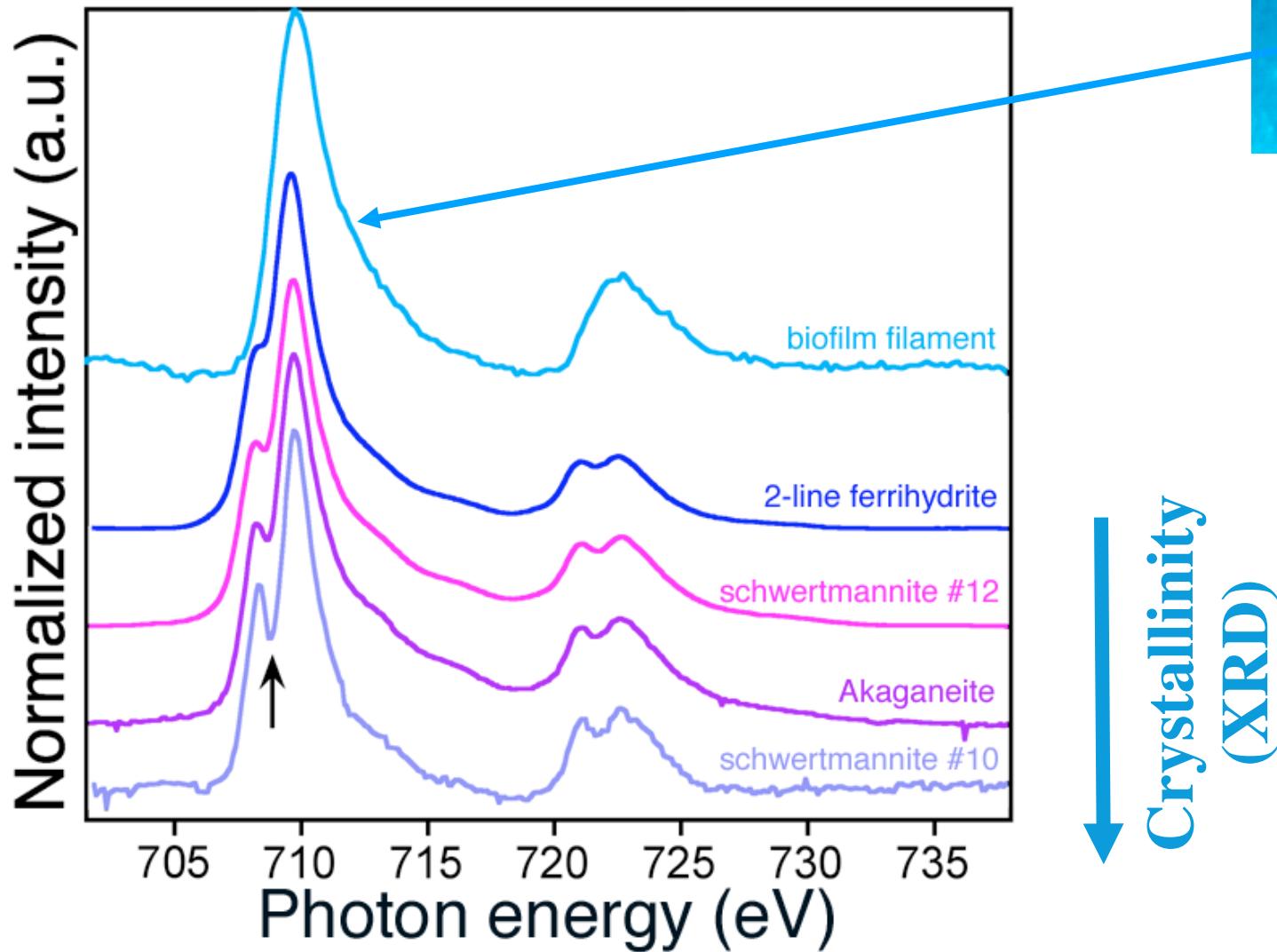
ROIs for “NM filaments” spectrum



again, C-O bond
(in COO⁻, templation site!!)

from A. P. Hitchcock

Crystallinity in Fe-oxide minerals



Organic-inorganic templates

Biomineralized structures:

Shells

Corals

Foraminifera

Crustacean shells

Bone, Dentine, Enamel

Bacterial Biominerals

Conclusions

Microscopy:

**micro- and nano-elemental composition
of cells, tissues and minerals.**

Spectroscopy:

- **Organic-inorganic templates are now accessible to XANES in the soft-x-ray range**
- **Protein binding and folding (fundamental in all biosystems) might be understood at the molecular level.**

Soft-x-ray beamline at APS:

- **Broad energy range:** C (285 eV), P (135 or 2146), S (163 or 2472 eV)
- **High flux density:** at least 1×10^9 photons/(s \times μm^2)

Acknowledgements

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(Animal Health & Biomed. Science)
- * **Joel Pedersen, Kristen Phillips** UW-Madison (Soil Science)
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